



United States
Department of
Agriculture



Center for
Nutrition Policy
and Promotion

CNPP-8A

Review of the Nutritional Status of WIC Participants

Executive Summary

Carol S. Kramer-LeBlanc, Ph.D. (Project Leader)
Anne Mardis, M.D., M.P.H.
Shirley Gerrior, Ph.D.
Nancy Gaston, M.A.

August 1999

It's Easy To Order Another Copy!

Just dial 1-800-720-USDA. Toll free in the United States and Canada.

Ask for *Review of the Nutritional Status of WIC Participants, Executive Summary*

For additional information about CNPP publications, databases, and other products, both paper and electronic, visit the CNPP Home Page on the Internet at <http://www.usda.gov/CNPP>

National Agricultural Library Cataloging Record:

Center for Nutrition Policy and Promotion

(CNPP-8A)

1. WIC Program—United States
2. Nutrition policy—United States
3. Special Supplemental Nutrition Program—United States
4. Women, Infants, Children Nutrition—United States
5. Nutrient Status—United States
6. Low income—United States
7. Food assistance programs—United States

Review of the Nutritional Status of WIC Participants. 1999. By Carol Kramer-LeBlanc, Anne Mardis, Shirley Gerrior, and Nancy Gaston. Center for Nutrition Policy and Promotion, U.S. Department of Agriculture. CNPP-8A.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, or marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.

Review of the Nutritional Status of WIC Participants: Executive Summary. 1999. By Carol Kramer-LeBlanc, Anne Mardis, Shirley Gerrior, and Nancy Gaston. Center for Nutrition Policy and Promotion, U.S. Department of Agriculture. CNPP-8A.

Abstract

This review of the nutrient intake of participants in the Special Supplemental Nutrition Program for Women, Infants, and Children—the WIC Program—compares the nutritional content of reported food intake to current nutritional standards and assesses the potential contribution of WIC supplemental nutrition packages to the diet quality of participant groups. Results of the review indicate that whereas infants and children appear to achieve good nutrient intake—with the exception of low zinc intake in children—women’s diets need improvement. Pregnant women report lower than recommended energy intake and need to improve consumption of calcium, iron, folic acid, zinc, vitamin B6, and magnesium. WIC breast-feeding women need to improve consumption of vitamin C and iron as well as vitamin B6, magnesium, and zinc. Non-breast-feeding postpartum women report low energy intake as well as low nutrient intake of WIC target nutrients. Recommendations for the WIC program include package modifications in some cases and nutrition education.

Keywords: WIC Program; Special Supplemental Nutrition Program for Women, Infants, and Children; food assistance; nutrition assistance; nutrition policy; children’s nutrition

Acknowledgments

Valuable information was provided by staff at the Food and Nutrition Service, especially Rhonda Kane and Jay Hirschman. Shirley Watkins, Under Secretary for Food, Nutrition and Consumer Services, and Julie Paradis, Deputy Under Secretary for Food, Nutrition, and Consumer Services, and Rajen Anand, Executive Director of the Center for Nutrition Policy and Promotion, were invaluable mentors and supporters of this work.

U.S. Department of Agriculture
Center for Nutrition Policy and Promotion
1120 20th Street NW, Suite 200 North Lobby
Washington, DC 20036

Foreword

I am delighted to present this *Review of the Nutritional Status of WIC Participants* prepared by the Center for Nutrition Policy and Promotion. The report describes results of a comprehensive examination of the diet of participants in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) in light of current nutritional standards, including Recommended Dietary Allowances, Dietary Guidelines for Americans, and the Food Guide Pyramid. The report has verified that infants and children who participate in the program achieve recommended nutrient intake (with the exception of zinc) but has identified certain shortfalls in nutrient needs of women in the target population.

The WIC Program, established 25 years ago, provides free, nutritious, supplemental foods, nutrition education, and health care referrals to low-income, pregnant, postpartum, and breast-feeding women, and to infants and children under the age of 5, who are judged at nutritional risk by health professionals. The program, which is one of the most successful nutrition assistance programs in USDA, has focused historically on supplying participants with supplemental protein and four important micronutrients: Vitamins A and C, calcium, and iron. Recent research has also identified folic acid, zinc, vitamin B6, and magnesium as micronutrients of concern in the population. This report examines the extent to which the WIC population is meeting nutritional requirements, as we currently understand them, and looks at the contribution of the WIC packages in providing these nutrients.

The Secretary of Agriculture committed the Department to undertake a comprehensive study of the nutritional adequacy of the WIC Program. The Center for Nutrition Policy and Promotion was charged to conduct the review. The able staff of the Center completed this study using data from the Third National Health and Nutrition Examination Survey (NHANES III) conducted from 1988 to 1994.

I would like to take this opportunity to acknowledge the contribution of Carol Kramer-LeBlanc, Anne Mardis, Shirley Gerrior, and Nancy Gaston in conducting this review and writing this report.

Rajen S. Anand, Ph.D.
Executive Director
USDA, Center for Nutrition Policy and Promotion

Review of the Nutritional Status of WIC Participants

Executive Summary

Introduction

The Secretary of Agriculture committed the Department to conduct a comprehensive study of the nutritional adequacy of supplemental food packages provided in the WIC Program (The Special Supplemental Nutrition Program for Women, Infants, and Children). The Center for Nutrition Policy and Promotion (CNPP) is charged with the Department's nutritional review. The goal of the review is to assess how well the WIC food packages perform as supplemental food packages assisting low-income recipients to meet nutritional standards for a healthful diet. The goal has three component tasks: (1) identify current nutritional recommendations for each of the WIC participant groups; (2) assess the diets of WIC participants in light of these standards; (3) examine the contribution of the WIC food packages to meeting the standards. From this assessment, any nutrient gaps or excesses among the WIC populations can be identified, along with opportunities for improving the WIC packages.

Background

The WIC Program was established in 1972 by an amendment to the Child Nutrition Act of 1966 and provides free, nutritious, supplemental foods, nutrition education, and health care referrals to low-income, pregnant, postpartum and breast-feeding women, and to low-income infants and children under the age of 5 who are judged at nutritional risk by professionals. The WIC food packages, which are supplemental by legislative intent, contain foods rich in nutrients or food components that are limited in the diets of targeted participant groups. Legislation leaves the definition or interpretation of "supplemental" and the selection of WIC foods to the discretion of the Secretary of Agriculture. The Program has focused historically on supplying participants with protein and four important micronutrients: Vitamins A and C, calcium, and iron. More recently, nutrition research has identified other micronutrients of potential concern, folic acid, zinc, vitamin B6, and magnesium. In addition, concern with other food components has surfaced; for example, Section 17(f)(12) of the Child Nutrition Act directs the Department to assure to the extent possible that the fat, sugar, and sodium content of WIC food packages is appropriate. The 1980 rule-making process restricted the amount of sugar permitted in WIC cereals to 6 grams per ounce of cereal and limited the amount of cheese in food packages, to curb sodium levels. Over the past several years, USDA has been questioned by members of Congress as well as the food industry as to the scientific basis for continuation of the Federal 6-gram sugar limit for WIC-eligible adult cereals.

Study Objectives

The goal of the review is to assess how well the WIC food packages perform as supplemental food packages assisting low-income recipients to meet nutritional standards for a healthful diet. The goal has three component objectives:

- (1) Identify current Federal nutritional recommendations for each of the WIC groups;
- (2) Assess the diets of WIC participants in light of these standards;
- (3) Examine the contribution/potential contribution of the WIC food packages to meeting the standards.

From this assessment, nutrient gaps or excesses among the WIC populations can be identified, along with opportunities for improving the WIC packages.

Objective (1): Nutrition Standards

The study identifies current recommended nutrition standards for each WIC participant group, using the National Research Council's 1989 Recommended Dietary Allowances (RDAs) for protein and the four WIC target nutrients (vitamins A and C, calcium, and iron) plus folic acid, zinc, vitamin B6, and magnesium, as well as the Recommended Energy Allowances (REAs) for total energy. The *1995 Dietary Guidelines for Americans* (U.S. Department of Agriculture/ U.S. Department of Health and Human Services, 1995) and the Food Guide Pyramid (U.S. Department of Agriculture, Human Nutrition Information Service, 1992) are referenced for recommendations pertaining to total fat, saturated fat, sugars, cholesterol, and sodium.

Reference values based on nutrition standards were interpolated by nutritionists where the age/sex group receiving a package did not match the age/sex groups referenced in the RDAs or other guidelines. Children were broken into two groups to match the corresponding reference values for each group. WIC Package IV is for 1- through 4-year-old children. Four-year-old children were considered separately from 1- to 3-year-olds and compared to standards for 4- to 6-year-old children. Pregnant and breast-feeding women (who receive WIC package V) are also considered separately due to differences in reference values for nutrients and other dietary components. Additionally, breast-feeding women may receive WIC Package VII, which is an enhanced package for exclusively breast-feeding women. This package was added to the

WIC Program in 1992 to encourage breast-feeding. Where reference values are specified for different ages of women, a value for all women in a participant group was also interpolated.

Objective (2): Assess the diet of WIC participants

CNPP utilizes total daily nutrient intakes of all foods reported consumed by individuals in WIC target groups and comparison groups in the nationally representative Third National Health and Nutrition Examination Survey (NHANES III) conducted from 1988 to 1994. NHANES III is a periodic survey conducted by the National Center for Health Statistics of the Department of Health Human Services (DHHS) and is used extensively in policy formulation, program planning and evaluation, regulatory analysis, education, and research. This survey includes data which represents the health and nutritional status of the civilian, non-institutionalized population of the United States and contains information on food and nutrient intakes and socioeconomic data on households and individuals. Total daily dietary nutrient intake of individuals in the survey is the calculated sum of nutrients of all foods reported consumed in 1 day, based on a single, 24-hour dietary recall interview. NHANES III was used because it contains larger sample sizes of women and children that would be covered by the WIC Program than the other major Federal dietary intake survey considered (the 1994-96 Continuing Survey of Food Intakes by Individuals).

The median total dietary intakes of six WIC participant subgroups for the WIC target nutrients,¹ four selected additional nutrients of potential public health significance, and other dietary components² were calculated. These subgroups include: infants 2-3 months who receive WIC Package I; infants 4-11 months who receive WIC Package II; children 1 through 4 years who receive WIC Package IV; pregnant and breast-feeding (up to 12 months postpartum) mothers who receive WIC package V; and non-breast-feeding mothers up to 6 months postpartum who receive WIC Package VI. WIC Package III is a “prescription” package for individuals with special dietary needs (such as phenylketonuria). It is a heterogeneous group and is not included in the analysis.

WIC Package VII is an enhanced version of WIC Package V for women who are exclusively breast-feeding. All breast-feeding women are analyzed in one group. Total dietary

intakes of the nutrients and dietary components for each participant group were compared to reference values based on the current nutrition standards described above.

In order to assess how participation in the WIC Program may affect diet quality, nutrient intakes of WIC participant groups were compared to WIC-income-eligible non-participants and separately to the overall NHANES III sample using two sample t-tests with standard errors calculated by SUDAAN statistical software (Shah et al., 1997) and an alpha level of 0.05. To assess the populations with the lowest nutrient intakes, the 10th percentile of daily nutrient intakes were examined.

Objective (3): Assess the contribution of the WIC packages to meeting nutrition standards

The nutrient content of the prototypical “maximum WIC food package” for each participant group is utilized to assess the potential contribution of the WIC food package to meeting recommendations. The nutrient content of the “maximum package,” or the maximum amount of food one person could theoretically receive, was analyzed by The Pennsylvania State University in a 1991 review of the WIC Food Packages (U.S. Department of Agriculture, Food and Nutrition Service, 1991). The possible outcomes are that the target group achieves the recommendation or not. If it does not, then we look to see if this could be explained because the WIC package does not contain sufficient quantities of the nutrients. If the package contains the nutrients in question while the reported intake does not, then we conclude that the foods are not being consumed by the target group. Potential reasons which we are now investigating include food consumption by other household members, food preferences, or lack of effective nutrition education.

Results

WIC Infants 2-3 months

There appears to be little concern regarding achieving recommended nutrient intakes among formula-fed WIC infants 2-3 months (all groups) for energy and WIC-target nutrients (protein, iron, calcium, vitamin A, and vitamin C) (Table ES-1). Breast-fed infants are not included in this analysis because of the difficulty of quantifying milk intake. WIC Package I (mainly formula) provides 81 percent of the RDA for calories and over 100 percent of the RDA for WIC target nutrients. Intake of other nutrients of public health importance (folic acid, zinc, vitamin B6, and magnesium) are similarly over 100 percent of RDA in the diets of these infants. Infants 2-3

¹Vitamin A, vitamin C, calcium, iron, and protein.

²Folic acid, magnesium, zinc, vitamin B6, total carbohydrate, sucrose, fructose, galactose, glucose, lactose, maltose, sodium, dietary fiber, cholesterol, total fat, and saturated fatty acids.

Table ES-1. Nutrient intake of infants 2-3 months compared to WIC package and RDA

Total energy and nutrients	RDA	Maximum package content		Median	Total nutrient intake		
		Amount	% of RDA		Standard error	% of RDA	(95% C.I. *)
Total energy (kcal)	650	528	81	665.7	19.59	102	(97%, 161%)
Protein (gm)	13	11.7	90	14.9	0.67	114	(105%, 216%)
Iron (mg)	6	9.5	158	14.3	0.78	238	(213%, 493%)
Calcium (mg)	400	399	100	567.4	27.50	142	(128%, 277%)
Vitamin A (IU)	1250	1591	127	1952.6	85.84	156	(143%, 291%)
Vitamin C (mg)	30	47	157	68.7	4.63	229	(199%, 531%)
Folic acid (mcg)	25	80	320	91.9	4.00	368	(336%, 681%)
Zinc (mg)	5	3.9	78	5.1	0.15	102	(96%, 161%)
Vitamin B6 (mg)	0.3	0.3	100	0.5	0.01	410	(143%, 215%)
Magnesium (mg)	40	32	80	61.4	3.89	154	(134%, 344%)

*C.I. = confidence interval.

months usually drink iron-fortified formula with little or no supplementary feeding of solid foods and nutrient intakes are similar for WIC and non-WIC groups at median levels.

WIC Infants 4-11 months

For WIC infants 4-11 months, median energy intake is above 100 percent of the Recommended Energy Allowance (REA) at 109 percent (Table ES-2). WIC Package II supplies 80 percent of the REA. Analysis shows that WIC infants 4-11 months achieve well over 100 percent of the RDA for WIC target nutrients (iron, calcium, vitamin A, vitamin C, and protein); they also receive over 100 percent of the additional nutrients of concern (folic acid, zinc, vitamin B6, and magnesium).

WIC Children 1-3 years old

Children 1-3 years were examined separately from 4-year-olds because of different recommended intake levels. Most WIC children 1-3 years old consume adequate calories and levels of most nutrients. WIC Package IV provides 65 percent of the REA of 1,300 calories per day (Table ES-3). WIC children 1-3 years consume 308 percent of the RDA for protein, slightly under 100 percent for iron and calcium, and well over 100 percent of the RDA for vitamin A and vitamin C. As Table 3 shows, the median intake for folic acid, vitamin B6, and magnesium are all over the RDA. Only zinc intake is

lower than recommended levels, with the median intake only 66 percent of the RDA for this group. However, this should be interpreted with caution due to current thought which suggests that the RDA for zinc may be set too high for children. The maximum WIC package content of zinc is 41 percent of the RDA.

WIC Children 4 years old

WIC children 4 years old, consume 88 percent of the REA of 1,800 kilocalories established for this age group (Table ES-4). CNPP has analyzed food consumption data reported for all children in this age group from the Continuing Survey of Food Intakes by Individuals (1989-91) and estimates that the average consumption of 1,530 calories is nutritionally adequate in light of growing concerns about obesity among elementary school children. Because of growing concerns about an obesity “epidemic” in the United States, affecting even children of elementary school age, it is not prudent to urge parents to feed children more food than they may need.

The WIC package for this group provides about 47 percent of the established REA. WIC children receive adequate (greater than 100 percent of the RDA) protein, iron, calcium, vitamin A, and vitamin C (the WIC target nutrients). They also receive adequate folic acid, vitamin B6, and magnesium. Like the other children 1-3 years old, however, this group has low zinc intake—reported at 76 percent of the RDA.

Table ES-2. Nutrient intake of infants 4-11 months compared to WIC package and RDA

Total energy and nutrients	RDA	Maximum package content		Median	Total nutrient intake		
		Amount	% of RDA		Standard error	% of RDA	(95% C.I. *)
Total energy (kcal)	803	646	80	872.0	15.39	109	(105%, 112%)
Protein (gm)	14	13.2	94	21.3	0.54	152	(145%, 160%)
Iron (mg)	9	26.4	293	16.9	0.50	187	(177%, 199%)
Calcium (mg)	554	592	107	616.2	13.20	111	(107%, 116%)
Vitamin A (IU)	1250	1602	128	3005.9	146.01	240	(218%, 263%)
Vitamin C (mg)	34	85	250	103.7	4.83	305	(277%, 333%)
Folic acid (mcg)	33	86	261	112.5	3.27	341	(321%, 360%)
Zinc (mg)	5	4.4	88	5.7	0.15	113	(108%, 120%)
Vitamin B6 (mg)	0.5	0.4	80	0.7	0.01	130	(136%, 144%)
Magnesium (mg)	55	80	145	97.0	2.47	176	(168%, 185%)

*C.I. = confidence interval.

Table ES-3. Nutrient intake of children 1-3 years old compared to WIC package and RDA

Total energy and nutrients	RDA	Maximum package content		Median	Total nutrient intake		
		Amount	% of RDA		Standard error	% of RDA	(95% C.I. *)
Total energy (kcal)	1300	849	65	1313.2	26.52	101	(97%, 105%)
Protein (gm)	16	37.4	234	49.3	1.29	308	(292%, 324%)
Iron (mg)	10	11.4	114	9.6	0.33	96	(90%, 102%)
Calcium (mg)	800	986	123	788.2	28.38	99	(92%, 105%)
Vitamin A (IU)	1400	2913	208	2781.2	131.29	199	(180%, 217%)
Vitamin C (mg)	40	139	348	60.2	3.79	150	(132%, 169%)
Folic acid (mcg)	50	337	674	161.4	6.19	323	(299%, 347%)
Zinc (mg)	10	4.1	41	6.6	0.14	66	(63%, 69%)
Vitamin B6 (mg)	1	1.1	110	1.2	0.03	117	(114%, 126%)
Magnesium (mg)	80	158	198	175.8	6.06	220	(205%, 235%)

*C.I. = confidence interval.

Table ES-4. Nutrient intake of children 4 years old compared to WIC package and RDA

Total energy and nutrients	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I. *)
Total energy (kcal)	1800	849	47	1584.2	65.01	88	(81%, 95%)
Protein (gm)	24	37.4	156	59.7	4.66	249	(211%, 287%)
Iron (mg)	10	11.4	114	11.3	0.64	113	(100%, 126%)
Calcium (mg)	800	986	123	794.7	60.3	99	(85%, 114%)
Vitamin A (IU)	1400	2913	208	2636.0	317.99	188	(144%, 233%)
Vitamin C (mg)	45	139	309	54.1	9.38	120	(79%, 161%)
Folic acid (mcg)	75	337	449	180.3	20.75	240	(186%, 295%)
Zinc (mg)	10	4.1	41	7.6	0.53	76	(66%, 86%)
Vitamin B6 (mg)	1.1	1.1	100	1.4	0.06	130	(117%, 138%)
Magnesium (mg)	120	158	132	178.6	13.55	149	(127%, 171%)

*C.I. = confidence interval.

WIC Pregnant Women

WIC women of all categories demonstrate nutrient deficits in their diets. WIC pregnant women report consuming only 70 percent of the REA for kilocalories, 44 percent of the iron RDA, and 60 percent of the calcium RDA—all WIC target nutrients (Table ES-5). The WIC packages alone, at maximum levels, could provide 35 percent of kilocalories, 71 percent of protein, 37 percent of iron, and 99 percent of calcium. Consumption of vitamin A (IU) appeared sufficient at a median of 122 percent of RDA; the median consumption of vitamin C was 100 percent of the RDA but with a potentially large variation.

Four additional nutrients of concern appeared to be low in the diets of WIC pregnant women: folic acid (58 percent RDA), zinc (61 percent RDA), vitamin B6 (77 percent), and magnesium (69 percent). These nutrients are recommended for explicit inclusion in the mix of WIC foods provided to WIC population subgroups as new target nutrients. Currently, the WIC maximum package supplies 81 percent of the RDA for folic acid (as opposed to 58 percent of the RDA consumed); 31 percent of the zinc RDA (as opposed to 61 percent RDA consumed); 50 percent of the RDA for vitamin B6 (as opposed to 77 percent RDA consumed); and 60 percent of the magnesium RDA (compared to 69 percent RDA consumed). (These levels do not reflect recent folic acid fortification requirements for cereal grains, which took place after the survey dates of 1988-94.) For these women, the percentage of calories from

macronutrients fell below the 55 percent from carbohydrate minimum recommendation and exceeded the 30 percent of calories from the maximum recommendation for fat and the 10 percent of calories from the maximum recommendation for saturated fat.

WIC Breast-feeding, Postpartum Women

WIC-participating women in the 12 months after giving birth had energy intakes at 89 percent of the REA (Table ES-6). Additionally, they failed to meet 100 percent of the RDA for WIC target nutrients vitamin C and iron, as well as for other nutrients of public health concern (vitamin B6, magnesium, and zinc). Breast-feeding women had significantly higher cholesterol intake (with amounts above recommendation) than comparison groups.

WIC Non-breast-feeding, Postpartum Women

This study identifies non-breast-feeding, postpartum women as having marked dietary nutrient intake inadequacies (Table ES-7). Total kilocalorie intake is 87 percent of the REA. Except for protein, they are consuming less than 100 percent of the RDA for the WIC target nutrients and nutrients of concern. A supposition may be made that they are not consuming their WIC food package, as the package supplies adequate quantities of these nutrients. Percent of calories from macronutrients does not fall in the professionally accepted proportions of kilocalories from total carbohydrates (55 percent), protein (15 percent), total fat (30 percent), and saturated fat

Table ES-5. Nutrient intake of pregnant women compared to WIC package and RDA

Total energy and nutrients	RDA	Maximum package content		Median	Total nutrient intake		
		Amount	% of RDA		Standard error	% of RDA	(95% C.I. *)
Total energy (kcal)	2500	863	35	1757.0	243.4	70	(51%, 89%)
Protein (gm)	60	42	71	62.6	11.54	104	(67%, 142%)
Iron (mg)	30	1.1	37	13.2	2.39	44	(28%, 60%)
Calcium (mg)	1200	1193	99	716.0	119.17	60	(40%, 79%)
Vitamin A (IU)	2650	3775	142	3221.4	421.44	122	(90%, 153%)
Vitamin C (mg)	70	141	201	70.2	25.80	100	(28%, 173%)
Folic acid (mcg)	400	323	81	233.6	45.93	58	(36%, 81%)
Zinc (mg)	15	4.7	31	9.1	1.33	61	(43%, 78%)
Vitamin B6 (mg)	2.2	1.1	50	1.7	0.31	77	(50%, 105%)
Magnesium (mg)	320	193	60	221.3	41.47	69	(44%, 95%)

*C.I. = confidence interval.

Table ES-6. Nutrient intake of breast-feeding women compared to WIC package and RDA

Total energy and nutrients	RDA	Maximum package content		Median	Total nutrient intake		
		Amount	% of RDA		Standard error	% of RDA	(95% C.I. *)
Total energy (kcal)	2700	837	31	2411.0	194.23	89	(75%, 103%)
Protein (gm)	65	41.8	64	97.7	4.19	150	(138%, 163%)
Iron (mg)	15	11.4	76	13.2	2.06	88	(61%, 115%)
Calcium (mg)	1200	1172	98	1442.6	228.49	120	(83%, 158%)
Vitamin A (IU)	4350	3723	86	4809.0	1292.48	111	(52%, 169%)
Vitamin C (mg)	94	141	150	67.0	30.54	71	(8%, 135%)
Folic acid (mcg)	277	344	124	284.5	133.90	103	(8%, 197%)
Zinc (mg)	19	4.7	25	13.6	1.36	72	(58%, 86%)
Vitamin B6 (mg)	2.1	1.1	52	1.8	0.22	84	(65%, 106%)
Magnesium (mg)	353	183	52	297.7	71.55	84	(45%, 124%)

*C.I. = confidence interval.

Table ES-7. Nutrient intake of non-breast-feeding women compared to WIC package and RDA

Total energy and nutrients	RDA	Maximum package content		Total nutrient intake			
		Amount	% of RDA	Median	Standard error	% of RDA	(95% C.I. *)
Total energy (kcal)	2200	654	30	1913.0	152.43	87	(73%, 101%)
Protein (gm)	48	33.2	69	77.7	9.84	162	(122%, 202%)
Iron (mg)	15	10.6	71	12.6	1.25	84	(68%, 100%)
Calcium (mg)	1069	997	93	636.4	60.43	60	(48%, 71%)
Vitamin A (IU)	2650	3382	128	2999.5	534.54	113	(74%, 153%)
Vitamin C (mg)	60	101	168	35.9	6.07	60	(40%, 80%)
Folic acid (mcg)	180	258	143	174.5	8.82	97	(87%, 107%)
Zinc (mg)	12	3.7	31	11.7	1.80	98	(68%, 127%)
Vitamin B6 (mg)	1.6	1	63	1.4	0.13	89	(72%, 103%)
Magnesium (mg)	285	132	46	196.2	20.88	69	(54%, 83%)

*C.I. = confidence interval.

(10 percent). Instead, the median proportion of kilocalories from those macronutrients consumed was 47 percent, 16 percent, 36 percent, and 12 percent, respectively.

Impact of WIC Packages: Comparisons with WIC-Eligible Non-Participants

Among children 1-3 years old who consume at the low end of the nutrient distribution (10th percentile), comparing WIC participants (WICP) with low-income non-participants (WICNP), WICP do significantly better than WICNP for most nutrients. These WICP children 1-3 years old benefit from the WIC package for most nutrients, especially for protein, calcium, iron, folic acid, magnesium, and vitamin E. WICP zinc intakes are comparable to those of the other two groups. For children 1-3 years old, iron intakes are below the RDA. However, these younger WICP children have significantly higher intakes of iron as well as of vitamin C than WICNP.

For all children up to 5 years of age, intakes of calcium are below the RDA. Among children 4 years old, all three groups take in just below 100 percent of RDA for calcium (95-99 percent). WICNP and the total sample (TS) groups have greater intake of carbohydrate and dietary fiber than WICP. This may indicate the introduction of cereal earlier and in larger amounts. Also, the lower lactose and higher cholesterol in these groups could reflect greater use of whole milk.

Children 4 years old also consume below 100 percent of the REA, at 88 percent.

All groups of pregnant women need to improve their diets. All three study groups report less than 100 percent RDA for vitamin A, calcium, and iron. WICP take in more vitamin C than WICNP, but not more than TS. WICP have lower intakes of calcium than the other groups. Iron intakes are similarly low (44 percent of RDA) for all three groups. All three groups consume less than 100 percent of the RDA for folic acid, magnesium, zinc, and vitamin B6, with even lower intakes of these nutrients by WICP.

WIC pregnant women, despite the supplemental foods received, report consuming less than 100 percent of the RDA for the target nutrients, calcium and iron; and for nutrients of concern, folate, zinc, and vitamin B6. Intakes of these nutrients are lower than both the WICNP and TS groups. Problems with the dietary intake of these pregnant women are low energy intakes, low nutrient-density, and higher fat intakes than recommended.

Finally, despite the supplemental foods received, WICP breast-feeding women report lower intake than WICNP and TS lactating women for the target nutrients vitamin A, vitamin C, and iron. All postpartum women, including non-breast-feeding WIC participants, consume less than the RDA for most target nutrients and nutrients of concern.

Table ES-8. Consumption of added sugars in teaspoons

Group	Recommendation ¹ (Teaspoons of added sugar)	Actual total intake	Prototype WIC package contains: ²
Children 1-3 years old	Less than 5	11.5	1.3
Children 4 years old	Less than 8	16.8	1.3
Pregnant women	Less than 15	23	0.8 - 1.3
Breast-feeding women	Less than 17	17	0.8 - 1.3
Non-breast-feeding women	Less than 12	16	0.8

¹These values are suggested by the Food Guide Pyramid for different total energy intakes, assuming that other nutritional recommendations are met.

²This value was estimated by adding the added sugar content (defined as sucrose + glucose + galactose + maltose) of the “maximum amount” of peanut butter and ready-to-eat cereal (Kix cereal was used in this example), the only WIC foods that contain added sugar.

Findings Related to Sugars Intake

Because of recent interest in sugar and its effects, the study examined intake of total and component sugars—sucrose, fructose, glucose, galactose, lactose, and maltose—by study participant groups. Glucose is required by cells of the body to produce energy for cell functions. Carbohydrates in the diet, including sugars (simple carbohydrates such as monosaccharides and disaccharides) and starches (complex carbohydrates), are digested and metabolized in the gastrointestinal system primarily into glucose, and to a smaller extent, galactose and fructose. These monosaccharides are absorbed into the portal blood, which delivers them to the liver before they enter the systemic blood. Glucose is immediately available to cells, and galactose and fructose are further metabolized in the liver into glucose, slightly delaying their entry into the blood as glucose. The rate at which glucose enters the blood after a meal depends primarily on how much total carbohydrate is consumed, how the food is prepared (cooking speeds up digestion), what else is consumed (fat slows digestion down), and minimally on the type of carbohydrate consumed. The metabolic effects of glucose derived from different sugars and carbohydrates are mainly dependent on the amount and speed at which glucose enters the blood (glycemic response curve or glycemic index³), rather than from what form it originated (Ludwig et al., 1998; Lee and Wolever, 1998; Daly et al., 1997; Bantle, 1989; Bantle et al. 1983). Further,

there is no intrinsic difference in the way glucose, whether originating in added sugars versus naturally occurring sugars, is recognized by cells of the body (Guyton and Hall, 1996). The rate at which glucose becomes available in the blood affects hormonal secretion of insulin and glucagon, which regulate blood glucose levels and glucose entry into cells for energy production or storage. In populations with risk factors such as obesity and insulin resistance, diets including meals that produce a rapid rise in blood glucose have been associated with an increased risk of developing diabetes mellitus (Salmeron et al., 1997a, 1997b).

Dietary data in NHANES III do not include information on the amount of sugar added to foods in the manufacturing process. However, to get a sense of the role of added sugars in the total diet, we follow the convention used in the Pyramid Food Group Servings database, and assume that added sugars include sucrose, glucose, galactose, and maltose, and naturally occurring sugars include fructose and lactose. This method is not perfect and interpretation should be made with caution as some glucose occurs naturally (as in orange juice), and fructose can be added as a sweetener (such as high-fructose corn syrup).

Dietary guidance from the Food Guide Pyramid (U.S. Department of Agriculture, 1992) suggests teaspoon amounts of added sugar per day for selected calorie intake levels. When added sugar intakes were compared to suggested amounts in the Food Guide Pyramid, all groups of WIC children and women, with the exception of breast-feeding women, consumed more than the suggested amount (Table ES-8). Children 1-4 years old consume over twice the suggested amount. WIC

³Glycemic index is defined as the area under the glycemic response curve after consumption of 50 grams of carbohydrate from a test food divided by the area under the curve after consumption of 50 grams of carbohydrate from a control substance, either white bread or glucose.

pregnant women consume 1.5 times, and WIC non-breast-feeding women consume 1.3 times suggested amounts. Breast-feeding women do not exceed the suggested amount of added sugar. Although above the suggested amount, WIC children 1-3 years old consume significantly less added sugar than the total nationally representative comparison group. The contribution of the WIC package to added sugars in the overall diet is very low, coming from added sugars in peanut butter and ready-to-eat cereals. Of note is the fact that each of these groups consumes less than 55 percent of total calories from carbohydrates.

Looking at component sugars, lactose is the primary sugar consumed by infants in all three comparison groups, with WICP infants 4-11 months receiving a significantly higher intake of lactose than the other two groups (WICNP or TS). For children 1-3 years old, sucrose is the primary sugar consumed by all three groups; however, WICP children consume significantly less sucrose and other added sugar than the TS and receive a significantly lower percent of total energy from sucrose. For pregnant, breast-feeding, and non-breast-feeding postpartum mothers, there are no significant differences in total intakes of sugar among the three comparison groups (WICP, WICNP, TS).

Implications for WIC Food Packages:

- There were no nutrient shortfalls associated with WIC infants up to the age of 11 months.
- Among WIC children 1-4 years old, the only nutrient below 95 percent of the RDA is zinc, with reported intake at 66 percent of RDA.
- WIC children 4 years old have a slight kilocalorie deficit, with median intakes at 88 percent of the REA of 1,800 kilocalories.
- Children 1 through 4 years of age consume a median level of 11 to 17 teaspoons of added sugar, which is well above the recommended level of 5 to 8 teaspoons. However, CNPP estimates that the WIC packages supply only about 1 teaspoon of added sugar.
- All WIC women exhibit nutrient shortfalls in their diets. WIC pregnant women do not meet 100 percent of the RDA for four of the five target nutrients and for the four other nutrients of concern. Pregnant women report consuming only 70 percent of the REA for kilocalories, 44 percent of the iron RDA, and 60 percent of the calcium

RDA—all WIC target nutrients. The WIC maximum package provides 35 percent of recommendations for kilocalories, 71 percent of RDA for protein, 37 percent for iron, and 99 percent for calcium. WIC pregnant women may not be consuming all the WIC foods furnished by their packages or may not be redeeming the maximum amount of food from the vouchers. Further study is needed to understand the reason for this low nutrient intake.

- Problems with the dietary intake of WIC pregnant women are lower energy intakes, lower nutrient density, and higher percentage fat intakes than recommended. Although the WIC package is very low in added sugar, the overall intake of added sugar by pregnant women exceeds recommendations.
- A WIC group at particular nutritional risk appears to be non-breast-feeding postpartum women who may not be consuming their WIC packages. Further food behavior research to learn more about this group is recommended. Reasons for the low nutrient intakes in this group should be further examined.
- Protein intake is well above recommendations for all WIC participant groups as well as the WIC-income-eligible nonparticipating, and the total sample groups.
- All groups of women and children studied consume more than the suggested daily intake of added sugar (from the Food Guide Pyramid), with the exception of nursing mothers. The contribution of the WIC package to added sugars in the overall diet is very low, coming from added sugars in peanut butter and ready-to-eat cereals.

References

Bantle, J.P. 1989. Clinical aspects of sucrose and fructose metabolism. *Diabetes Care* 12:56-61.

Bantle, J.P., Laine, D.C., Castle, G.W., Thomas, J.W., Hoogwerf, B.J., and Goetz, F.C. 1983. Postprandial glucose and insulin responses to meals containing different carbohydrates in normal and diabetic subjects. *N. Engl. J. Med.* 309:7-12.

Daly, M.E., Vale, C., Walker, M., Alberti, K.G., and Mathers, J.C. 1997. Dietary carbohydrates and insulin sensitivity: A review of the evidence and clinical implications. *Am. J. Clin. Nutr.* 66:1072-1085.

Guyton and Hall. 1996. *Textbook of Medical Physiology* (9th ed.) W.B. Saunders, Philadelphia.

Lee, B.M. and Wolever, T.M. 1998. Effect of glucose, sucrose and fructose on plasma glucose and insulin responses in normal humans: Comparison with white bread. *Eur. J. Clin. Nutr.* 52:924-928.

Ludwig, D.S., Majzoub, J.A., Al-Zahrani, A., Dallal, G.E., Blanco, I., and Roberts, S.B. 1998. High glycemic index foods, overeating, and obesity. *Pediatrics* 103(3):E26. <http://www.pediatrics.org/cgi/content/full/103/3/e26>.

Salmeron, J., Ascherio, A., Rimm, E.B., Colditz, G.A., Spiegelman, D., Jenkins, D.J., et al. 1997a. Dietary fiber, glycemic load, and risk of NIDDM in men. *Diabetes Care* 20:545-550.

Salmeron, J., Manson, J.E., Stampfer, M.J., Colditz, G.A., Wing, A.L., Willett, W.C. 1997b. Dietary fiber, glycemic load, and risk of non-insulin-dependent diabetes mellitus in women [see comments]. *JAMA* 277:472-477.

Shah, B.V., Barnwell, B.G., and Bieler, G.S. 1997. SUDAAN Users Manual, Release 7.5. Research Triangle Institute, Research Triangle Park, NC.

U.S. Department of Agriculture, Food and Nutrition Service. 1991. Technical Papers. Review of WIC Food Packages. Prepared by The Pennsylvania State University, Department of Nutrition. Mary Frances Picciano, PhD, Principal Investigator.

U.S. Department of Agriculture, Human Nutrition Information Service. 1992. *The Food Guide Pyramid*. Home and Garden Bulletin No. 252.

U.S. Department of Agriculture and U.S. Department of Health and Human Services. 1995. *Nutrition and Your Health: Dietary Guidelines for Americans* (4th ed.). Home and Garden Bulletin No. 232.